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1961 Campbell Lecturer
Lawrence Darken
(See article, p. 5)

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July, 1961

SCIENCE & TECHNOLOGY

MR

METALS REVIEW

The News Digest Magazine

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The 16th METALLOGRAPHIC EXHIBIT

Detroit, October 23 to 27, 1961

All metallographers—
everywhere—
are cordially invited to
display their best work.

RULES FOR ENTRANTS

Exhibitors do not need to be members of the American Society for Metals.

Work which has appeared in previous metallographic exhibits held by the American Society for Metals is unacceptable.

Photographic prints should be mounted on stiff cardboard, extending no more than 3 in. beyond edge of print in any direction; maximum dimensions 14 by 18 in. (35 by 45 cm.). Heavy, solid frames are unacceptable.

Entries should carry a label on the *face of the mount* giving:

Classification of entry.

Material, etchant, magnification and other desirable data.

A brief statement (if desired) calling attention to any unusual aspect of the entry.

The name, company affiliation and postal address of the exhibitor should be placed on the *back of the mount* together with a request for return of the exhibit if so desired.

Entrants living outside the United States should send their micros by first-class letter mail endorsed "Photo for Exhibition — No Commercial Value — May Be Opened for Customs Inspection".

Exhibits must be delivered before Oct. 10, 1961, either by prepaid express, registered parcel post or first-class letter mail, addressed:

Metallographic Exhibit
American Society for Metals
Metals Park
Novelty, Ohio, U. S. A.

CLASSIFICATION OF MICROS

Class 1. Irons and steels, cast and wrought
Class 2. Stainless steels and heat resisting alloys
Class 3. Aluminum, magnesium, beryllium, titanium and their alloys
Class 4. Copper, nickel, zinc, lead and their alloys
Class 5. Uranium, plutonium, thorium, zirconium and reactor fuel and control elements
Class 6. Metals and alloys not otherwise classified
Class 7. Series showing transitions or changes during processing
Class 8. Welds and other joining methods
Class 9. Surface coatings and surface phenomena
Class 10. Slags, inclusions, refractories, cermets and aggregates
Class 11. Electron micrographs using replicas
Class 12. Electron micrographs (transmission)
Class 13. Color prints in any of the above classes
Class 14. Results by unconventional technique

AWARDS AND OTHER INFORMATION

A committee of judges will be appointed by the Metal Congress management which will award a First Prize (a medal and blue ribbon) to the best in each classification. Honorable Mentions will also be awarded (with appropriate medals) to other photographs which in the opinion of the judges closely approach the winner in excellence. A Grand Prize, in the form of an engrossed certificate and a money award of $500 from the Adolph I. Buehler Endowment will also be awarded the exhibitor whose work is judged best in the show, and his exhibit shall become the property of the American Society for Metals for preservation and display in the Society's national headquarters.

All prize-winning photographs will be retained by the Society for one year and placed in a traveling exhibit to the various Chapters.

43rd NATIONAL METAL CONGRESS & EXPOSITION

Cobo Hall, Detroit——————————Oct. 23 to 27, 1961

July, 1961 Vol. XXXIV, No. 7

METALS REVIEW

The News Digest Magazine

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The Editor's Page

No Novelty

For the past two years, we, and others of the ASM staff, have been trying to convince our friends that the name Novelty in our headquarters' address was a long established post office, not something devised to attract attention. Now such explanations become less necessary. As of July 1, ASM established its own postal station officially known as Metals Park. Thus, our address is now American Society for Metals, Metals Park, Ohio.

Materials Problems

If you think you have materials selection problems, please consider those of a firm making a new machine known as the Cocktailmatic. The machine automatically measures the ingredients of manhattans or martinis—including very, very dry. Problems are bilateral. In some instances, certain materials were affected by alcohols and thus had to be supplanted. In others, the materials adversely affected the color or taste of the beverage. It's nice to report that through intelligent materials engineering these problems are now solved and automation is ready to unburden the lives of bartenders to the point where they will be better able to perform their normal roles as combined philosophers — sympathizers — counselors — reporters.

Picture Pages

Have you noticed in the most recent issues of Metals Review the considerably enlarged pictorial coverage given to chapter and national Society affairs? The wisdom of the ancient Chinese philosopher who observed the fact that one picture is worth a big bundle of words is constantly reaffirmed. We sincerely hope that the extended use of photographs will have two related effects: (1) to raise the interest level of this publication, and (2) inspire chapter photographers to use their imaginations to provide us with more interesting shots to satisfy the increasing editorial appetite.

Metallographic Exhibit

In the event you have missed the remainder ads announcing the 16th ASM Metallographic Exhibit, let us jog your memory. The exhibit will accept entries until Oct. 10 for display at this year's Metal Show in Detroit. Each year an increasing number of photographs are entered to vie for honors as well as the $500 first prize granted by the Adolph I. Buehler Endowment. As many of you know, winners and honorable mentions from the exhibit are collected and shipped about the country as ASM's Traveling Metallographic Exhibit. Each year the exhibit is on display before chapter meetings, regional conferences and at selected universities. Make your own selection now and prepare to show your outstanding work in Detroit. Incidentally, winners from past years are soon to go on permanent display at Metals Park.

British Guests

ASM, together with the Metallurgical Society of AIME, is acting as host in the United States for a visit of The Iron and Steel Institute (London) during its meeting this fall. At the moment it appears that about 90 British and Continental members of ISI will be in a group which will include a trip to Detroit and the Metal Show in its itinerary. One of the prime events in which our guests will participate is ASM's annual banquet. Speaking of the banquet, we can now issue a tip on the speaker. He will be one of the country's leading figures in the military space program.

Northern Activity

One of our most recent trips took us to Edmonton, Alberta, Canada, to be present at a meeting of the three ASM chapters in the province of Alberta. Aside from the warmly hospitable greeting of the men present, our major impression gained from the visit is of the tremendously increasing industrial activity in the area. Much of the recent growth there has resulted from activity in the oil and gas industries. However, the abundantly available low-cost fuel supply has resulted in a growing steel industry and the rapidly expanding petro-chemical industry is building extensively.

Metal Show

By this time you will have received your housing bureau form covering this fall's Metal Show and Congress. To assist you in picking the most suitable time for your visit, a condensed program of technical program sessions is included as part of this early mailing.

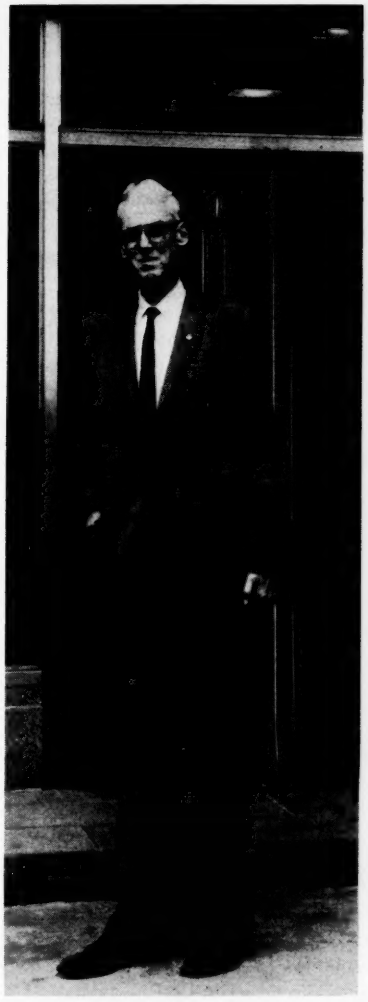
Apart from the Saturday and Sunday Seminar, on Ultra-High Purity Metals, there will be a minimum of 55 other sessions during the five days of the Metal Congress. Groups staging or cooperating in presentation of technical programs include: the Society for Nondestructive Testing; The Metallurgical Society of AIME; the American Welding Society; American Gas Association; Industrial Heating Equipment Association; Metal Powder Industries Federation; Metal Treating Institute; Ultrasonics Manufacturers Association and the Metals Branch of the Special Libraries Association.

These, plus the Materials Comparison Center, Detroit's Cobo Hall and the Nation's largest concentration of materials exhibits, add up to an exciting event you won't want to miss.

T. C. Du Mond

ASM Members—Admission to the National Metal Congress and Exposition is by your ASM Membership Card or $2.00. Don't forget your membership card!

L. S. Darken, 1961 Campbell Memorial Lecturer



Lawrence Darken
1961 ASM Campbell
Memorial Lecturer

Lawrence Darken, associate director of United States Steel's Edgar C. Bain Fundamental Research Laboratory, has crowded a wealth of experimental theoretical research experience into his 26 years with the company. Engaged in many areas of both physical and chemical metallurgy—the common thread being, most frequently, metallurgical thermodynamics and diffusion theory—his pioneering efforts in science were achieved in a field in which few others worked, until recently. This is a remarkable record when you consider that it is much less difficult to grow professionally in a field where constant interaction and interchange of ideas exists.

Contributing in quality and quantity to the literature, Dr. Darken has advanced scientific knowledge in areas such as kinetics of metallurgical processes, the phenomenological basis of diffusion theory, equilibria in the iron-oxygen system and in the openhearth, as well as hydrogen behavior in steel.

Born in Brooklyn, N.Y., on Sept. 18, 1909, Larry Darken attended Brooklyn public schools, and later, schools in Allendale and Ramsey, as his father, an insurance man and a native New Yorker, braved the "wilds" of New Jersey. In 1926, his interest in science and mathematics prompted him to continue his studies at Hamilton College in Clinton, N.Y., a small liberal arts school with a high academic reputation. Graduating in 1930 (with a Root Fellowship) he went on to Yale; here he later held the Loomis Fellowship and graduated with a Ph.D. in physical chemistry. He remained another year as post-doctoral fellow and then left the University just in time to greet the Depression.

In the understatement of the month Larry recalls, "Things were different for a Ph.D. graduate in the 'good old days' ". At Hamilton, he was elected to Phi Beta Kappa, and at Yale to Sigma Xi, the equivalent scholastic honorary society in the sciences.

The beginning of Larry's long association with U.S. Steel's Research Laboratories (then at Kearney, N.J.; now at Monroeville, Pa.) coincided with the decision of the director, Dr. John Johnston, to introduce more physical chemistry into his metallurgical research programs. Dr. Darken saw this as a golden opportunity to apply his knowledge and experience in physical chemistry to a field in which very little work had been accomplished up until this time (except by the Germans).

In addition to his research work at U.S. Steel, Dr. Darken was also Adjunct Professor (from 1944 to 1953) at the Polytechnic Institute of Brooklyn, where he taught graduate courses in physical chemistry of metals, metallurgical thermodynamics and the phase rule.

Larry met his wife (Margaret FitzGerald, A.B., Hunter College, 1933; Ph.D., Yale, 1936) while they were both at Yale. They were married in 1939. Since he and his wife are the parents of six children, he enjoys a variety of problems at home, ranging from those brought back for the holidays by a mathematics major at the University of California (Joanne Savage, 19, class of 1962), a chemistry major at Trinity College in Washington, D.C. (Mary Cummins, 18, class of 1964), to those furnished all year round by the younger Darkens — Lawrence Jr., 15, William 11, Marjorie 10 and Edward 6—in geometry, compound interest, long division and first-grade arithmetic.

To these "curricular" pleasures he can add the exercise of supervising the younger generation in mowing an acre of lawn atop a foothill of the Alleghenies and then vanquishing them at croquet or badminton. Larry occasionally bowls, golfs and plays some tennis; he used to take great pleasure in dismantling motors on cars, such as Model A's, until they got to be "too complicated".

An excellent bridge player, Larry is also an avid reader of "who-done-its" and books on the philosophy of science. His advice to young men contemplating a career in science: "Your big opportunity tomorrow will come if you are willing to cross fields to bring a knowledge, skill or technique that is already established in one area into another area of scientific interest—as when optical and electron microscopy moved from biology to metallurgy, or when isotope techniques were adopted in biology as well as in metallurgy.

Lawrence Darken, a distinguished scientist, is a man with keen insight into physical problems, a stimulating, fascinating individual who has demonstrated an excellent grasp of scientific fundamentals. A prolific writer, his scientific papers and reports are exceedingly well planned and are unusually readable, possibly due to his fine grounding in the liberal arts.

Working several nights a week and on vacations for six years, he co-authored (with Dr. R. W. Gurry) the book, Physical Chemistry of Metals, a standard senior and graduate text which is selling as well now as when published in 1953. His papers on the basic phenomenology of diffusion and on the thermodynamics of ternary and multicomponent systems have served as a basis for experimental work in these areas. He helped lay the foundation of our understanding of chemical rate phenomena in the openhearth; his work on the interaction of atoms with imperfections, on pearlite growth and on filamentary growth is also well known.

As a result of his outstanding and continuing contributions to science over a period of years, the National Academy of Science recently elected him to membership. Dr. Darken is the third scientist associated with U.S. Steel to receive this signal honor. It previously has been awarded to Dr. Edgar C. Bain, retired vice-president, and to Dr. Robert F. Mehl, now U.S. Steel's European research consultant in Zurich, Switzerland. Only five other members of the Academy have been active in the field of metallurgy: Dr. John Chipman, M.I.T.; Dr. Zay Jeffries, General Electric; Dr. Augustus B. Kinzel, Union Carbide; Dr. Cyril Stanley Smith, University of Chicago; and Dr. Clarence M. Zener, Westinghouse. All of the mentioned Academy of Science members have been Campbell Lecturers. Election to membership in the Academy is one of the highest honors that can be bestowed upon an American scientist or engineer. Dr. Darken is one of 35 persons throughout the country, from many fields, to be named this year. In addition, he is one of only two industry people—and the only representative of the steel industry—to receive membership in 1961.

This year's Campbell Memorial Lecture will be presented by Dr. Darken at Cobo Hall, 10:30 a.m., Wednesday, Oct. 25.

Edward DeMille Campbell was a scholar and teacher of great skill, understanding and courage. To commemorate his considerable achievements and honor a distinguished scientist each year, the American Society for Metals established, in 1925, the Campbell Memorial Lecture. Blind for all but two years of his professional life, Professor Campbell contributed 77 papers to the scientific literature, the majority of which dealt with a correlation of the chemical, physical and mechanical properties of steel.

Professor Campbell was born and raised in Detroit, and later attended the University of Michigan, graduating in 1886. After four years' work in the field as a metallurgical chemist, he returned to the University as an assistant professor of metallurgy. He organized the course in chemical engineering in 1902, held that professorship among his other titles for 12 years, and was director of the Chemical Laboratory from 1905 until his death in 1925.

Without exception, his many associates and former students felt deeply indebted to him for the personal interest he showed in their work and their lives. The training he gave them was no small factor in their fitness for important industrial and research positions. There is universal agreement that as an educator, Prof. Campbell stood in the front rank.

ASM Campbell Memorial Lecturers

William M. Guertler	1926	George R. Fitterer	1944
Zay Jeffries	1927	Maxwell Gensamer	1945
W. H. Hatfield	1928	James B. Austin	1946
Albert Sauveur	1929	Augustus B. Kinzel	1947
Marcus A. Grossmann	1930	Morris Cohen	1948
Charles H. Herty, Jr.	1931	Edgar H. Dix, Jr.	1949
Edgar C. Bain	1932	Earle C. Smith	1950
Herbert J. French	1933	Clarence H. Lorig	1951
Vsevolod N. Krivobok	1934	Cyril Stanley Smith	1952
Harry W. McQuaid	1935	Donald S. Clark	1953
James P. Gill	1936	Kent R. Van Horn	1954
Wesley P. Sykes	1937	Robert H. Aborn	1955
Alfred L. Boegehold	1938	Charles S. Barrett	1956
Edmund S. Davenport	1939	Earl R. Parker	1957
Samuel L. Hoyt	1940	Peter Payson	1958
Robert F. Mehl	1941	A. R. Troiano	1959
John Chipman	1942	Clarence Zener	1960
C. H. Mathewson	1943	Lawrence Darken	1961

ASM Transactions Committee's Technical Program for National Metal Congress Fills Many Needs

In recognition of the urgent need to communicate the significant advances in science in both width and depth, the technical program planned by the ASM Transactions Committee for presentation at the 43rd National Metal Congress will cover the new as well as established areas of metallurgical activity.

Of the ten sessions scheduled for Oct. 23 through Oct. 26, at Cobo Hall, Detroit, three sessions will be devoted to reports of scientific studies of steels and an equal number to metallurgical problems associated with nuclear and aerospace devices. Other subject areas that will receive attention are corrosion, iron-chromium alloys, plastic deformation and physical metallurgy.

Not only do the technical programs organized by the Transactions Committee provide a record of current advances in metal science, they also offer the established scientist and engineer an important means of preventing decadence of their technical knowledge.

Obsolescence in technical people is as real as with production tools and, as E. V. Murphree, president, Esso Research and Engineering Co., pointed out in an address last year: "A solid education, of course, is only the beginning. It is the learning that comes after school which prevents the malady of obsolescence in technical people".

Periodically, a considerable hue and cry is raised about certain specific skills being in "short supply", as though educational institutions should foresee the knowledge that will be required in work that not only does not yet exist but cannot even be defined. In this age of innovation in which we live and in which, according to James R. Killian, Jr., MIT board chairman, scientific knowledge is doubling in size about every nine years, the requisite to anything more than mere employability must be a self-imposed program of continuing education for professional development. The technical programs of the ASM Transactions Committee will continue to provide a careful selection of significant papers that are ideally suited for such self education.

American Society for Metals Technical Program

National Metal Congress and Exposition

Detroit, Oct. 23-26, 1961

Cobo Hall

MECHANICAL PROPERTIES OF STEELS

Monday, Oct. 23 — 9:00 a.m.

Presiding Officers

S. L. Gertsman, Dept. of Mines and Technical Surveys, Ottawa

George H. Enzian, Jones & Laughlin Steel Corp.

Some Parameters Affecting Fracture Toughness of High-Strength Steel, by Paul M. Lorenz, Boeing Airplane Co., Aero-Space Div., Seattle, Wash.

Yield Behavior of Certain Alloy Steels at Low Strain Values, by George S. Reichenbach, MIT, Cambridge, Mass., D. A. Brown, Stanford Research Institute, Palo Alto, Calif., and P. G. Russell, Alloyd Corp., Cambridge, Mass.

Noxious and Innocuous States of Hydrogen in Iron, by Daniel Jean-Paul Adenis, Dow Chemical Co., Midland, Mich., and W. M. Baldwin, Jr., Case Institute of Technology, Cleveland, Ohio

Effect of Temper Brittleness on Dry Friction Wear of a Martensitic Steel, by James J. Kauzlarich and Raymond R. Hagglund, Worcester Polytechnic Institute, Worcester, Mass., and James P. Modrak, Rochester Institute of Technology, Rochester, N. Y.

Repeated Tensile Loading of Iron and Steel, by C. P. Sullivan, B. L. Averbach and Morris Cohen, MIT, Cambridge, Mass.

STEELS

Monday, Oct. 23 — 2:00 p.m.

Presiding Officers

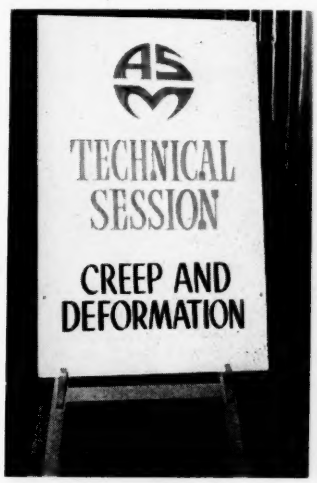
J. C. Hamaker, Jr., Vanadium Alloys Steel Co.

S. J. Rosenberg, National Bureau of Standards

Effect of Prestraining and Retempering on AISI Type 4340, by E. T. Stephenson, Bethlehem Steel Co., Bethlehem, Pa., and M. E. Cohen, MIT, Cambridge Mass.

Direct Reduction of Ferric Oxide by Solid Carbon in Vacuum, by T. S. Yun, Seoul National University, Seoul, Korea

The Effect of Concurrent Straining on the Annealing Behavior of a Cold Rolled Vacuum-Melted Electrolytic Iron, by Alfred Goldberg, Comision Ful-



bright de Intercambio Educativo, Lima, Peru, and Sumner Gurney, U. S. Naval Postgraduate School, Monterey, Calif.

Effects of Columbium on the Properties of Aluminum-Killed, Medium-Carbon Steel, by E. E. Fletcher and A. R. Elsea, Battelle Memorial Institute, Columbus, Ohio, and E. C. Bain, Consultant, Sewickley, Pa.

Some Processing Factors Affecting the Magnetic Properties of Low-Carbon Steel, by D. J. Knight and P. J. Adzema, Jones & Laughlin Steel Corp., Graham Research Laboratory, Pittsburgh

CARBIDES IN STEELS

Tuesday, Oct. 24 — 9:00 a.m.

Presiding Officers

David Krashes,
Worcester Polytechnic Institute

Fred Warner, Westinghouse Research Laboratories

A Study of Carbide Composition and Microstructure During the Quenching and Tempering of a 5% Cr-Mo-V Steel, by G. P. Contractor and W. A. Morgan, Dept. of Mines and Technical Surveys, Ottawa, Canada, and E. G. Schempp, Atlas Steels, Ltd., Welland, Canada

Creep Behavior of an Austenitic Stainless Steel as Effected by Carbides Precipitated on Dislocations, by Frank Garofalo, F. von Gemmingen and W. F. Domis, Edgar C. Bain Laboratory for Fundamental Research, U. S. Steel Corp., Monroeville, Pa.

Microstructural and Residual Stress Changes in Hardened Steel Due to Rolling Contact, by J. J. Bush, W. L. Grube and G. H. Robinson, Research Laboratories, General Motors Corp., Warren, Mich.

An Electron Transmission Study of the Tempering of Martensite in 0.42% Carbon Steel, by A. M. Turkalo, Metallurgy and Ceramics Research Dept., General Electric Co., Schenectady, N. Y.

IRON-CHROMIUM ALLOYS

Tuesday, Oct. 24 — 2:00 p.m.

Presiding Officers

T. W. Eichelberger, Westinghouse Research Laboratories

R. F. Hehemann,
Case Institute of Technology

Influence of Delta Ferrite-Carbide Segregates on Properties of 12% Chromium Steel, by E. A. Loria, Climax Molybdenum Co., Pittsburgh, Pa.

Submicroscopic Structures in Tempering 410 Stainless Steel, by J. J. Hauser, J. M. Capenos and B. R. Banerjee, Research Div., Crucible Steel Co. of America, Pittsburgh, Pa.

Relationship Between Fatigue and Damping Characteristics and Microstructure of 12% Cr Steels, by E. J. Dulis and V. K. Chandhok, Crucible Steel Co. of America, Pittsburgh, Pa., and J. P. Hirth, Carnegie Institute of Technology, Pittsburgh, Pa.

Tensile Properties of Single Crystals of Iron-Chromium Alloys, by G. T. Horne, R. B. Roy and H. W. Paxton, Carnegie Institute of Technology, Pittsburgh, Pa.

NUCLEAR METALS

Wednesday, Oct. 25 — 2:00 p.m.

Presiding Officers

R. E. Swift,
University of Kentucky

H. H. Chiswik,
Argonne National Laboratory

Liquid-Metal Fuel Constitutions III; Liquidus Curves of the Bismuth Fission-Product Systems, by D. G. Schweitzer and John R. Weeks, Brookhaven National Laboratory, Upton, N. Y.

Liquid-Metal Fuel Constitutions IV; Effects of Alkali Metals on the Solubility of Uranium in Bismuth, by D. G. Schweitzer and John R. Weeks, Brookhaven National Laboratory, Upton, N. Y.

Metallographic Studies of Al-Ni-U Bonds in Nuclear Fuel Elements, by C. L. Angerman, Savannah River Laboratory, E. I. du Pont, Aiken, S.C.

Audience interest is high at ASM technical session

Effect of Oxygen on Properties of Zircaloy-2, by L. S. Rubenstein, F. L. Shubert and J. G. Goodwin, Westinghouse Electric Corp., Bettis Atomic Power Div., Pittsburgh, Pa.

PLASTIC DEFORMATION

Wednesday, Oct. 25 — 2:00 p.m.

Presiding Officers

R. W. Guard, General Electric Co.

W. A. Backofen, MIT

Shear Deformation of Magnesium and Zinc Single Crystals, by W. L. Phillips, Jr., E. I. du Pont de Nemours & Co., Wilmington, Del.

Effect of Stress Decreases on Creep of Aluminum in the Dislocation Climb Region, by L. Raymond, W. D. Ludemann, N. Jaffee and J. E. Dorn, University of California, Berkeley

Investigation of the Intermediate Temperature Ductility Minimum in Metals, by F. N. Rhines and P. J. Wray, University of Florida, Gainesville

Cumulative Fatigue at High Plastic Strains, by Dogan E. Gucer, Technical University of Istanbul, Levent, Istanbul, Turkey

Centrifugal Creep Testing on Pure Aluminum, by D. E. Deutsch, R. S. Carey and J. L. Hull, Aerojet-General Nucleonics, San Ramon, Calif.

Transient and Destructive Instability in Torsion, by N. H. Polakowski and S. Mostovoy, Illinois Institute of Technology, Chicago

PHYSICAL METALLURGY

Thursday, Oct. 26 — 9:00 a.m.

Presiding Officers

W. R. Upthegrove,
University of Oklahoma

R. M. Parke,
University of Pennsylvania

Prediction of Atomic Mobility in Metallic Systems, by Oleg D. Sherby, Stanford University, Stanford, Calif., and Massoud T. Simnad, General Atomics Div., General Dynamics Corp., San Diego, Calif.

A New Method for Determination of Liquid-Liquid Equilibria as Applied to the Fe-C-Si-Mg System, by Paul K. Trojan and R. A. Flinn, University of Michigan, Ann Arbor

Measurement of Interlamellar Spacing of Pearlite, by B. Gregory, College of Science and Technology, Manchester, England, and H. T. Hall and G. Bullock, Allmanna Svenska Elektriska Aktiebolaget, Vasteras, Sweden

Quantitative Metallographic Analysis of Graphite Size in Ductile Cast Iron, by J. H. Brophy, MIT, Cambridge, Mass., and M. J. Sinnott, University of Michigan, Ann Arbor

Wrought Lead-Cadmium-Nickel Alloys, by D. N. Williams, K. R. Grube and R. I. Jaffee, Battelle Memorial Institute, Columbus, Ohio

SPACE AGE METALS — I

Thursday, Oct. 26 — 9:00 a.m.

Presiding Officers

D. J. Blickwede,
Bethlehem Steel Co.

A. R. Kaufmann,
Nuclear Metals, Inc.

Effect of Surface Finish on Properties of Beryllium Sheet, by W. V. Ward, International Nickel Co., Los Angeles, Calif., and C. O. Matthews and M. I. Jacobson, Lockheed Aircraft Corp., Sunnyvale, Calif.

Influence of Warm Prestressing on the Notch Properties of Several High-Strength Alloys, by E. A. Steigerwald, Thompson-Ramo-Wooldridge, Inc., Cleveland, Ohio

Strain Hardening Properties of High-Strength Sheet Materials, by Frank R. Larson and John Nunes, Watertown Arsenal Laboratories, Watertown, Mass.

Additive Effects of Alloying Elements on the Mechanical Properties of Cast Austenitic Alloys at 1500° F., by D. L. Sponseller and R. A. Flinn, University of Michigan, Ann Arbor, and R. W. Kraft, United Aircraft Corp., East Hartford, Conn.

Hardness Anistropy of Columbium, by D. L. Douglass, Vallecitos Atomic Laboratory, General Electric Co., Pleasanton, Calif.

SPACE AGE METALS — II

Thursday, Oct. 26 — 2:00 p.m.

Presiding Officers

S. W. Poole, Republic Steel Corp.

W. F. Brown, NASA

Constitution and Transformation Behavior of the Ti-8Al-8Zr-1 (Ta+Cb) Alloy, by Harold Margolin, New York University, New York, and Elmars Ence, Republic Aviation Corp., Farmingdale, N.Y.

Investigation of Notch Sensitivity in A-286 Alloy, by Gerald B. Heydt, Carpenter Steel Co., Reading, Pa.

Mechanical Properties of Unalloyed Vanadium, by John W. Farrell, Union Carbide Metals Co., Niagara Falls, N. Y.

Effect of Temperature Exposure on the Microstructure of 4.5% Ti Nickel-Base Alloy, by J. F. Radavich, Purdue University, West Lafayette, Ind., and W. H. Couts, Jr., General Electric Co., Cincinnati, Ohio

CORROSION

Thursday, Oct. 26 — 2:00 p.m.

Presiding Officers

P. D. Frost and F. W. Fink,
Battelle Memorial Institute

Morphology of Grain Boundary Carbides and Its Influence on Intergranular Corrosion of 304 Stainless Steel, by R. Stickler and A. Vinckier, Westinghouse Electric Corp., Research Laboratories, Pittsburgh, Pa.

Corrosion Resistance and Mechanical Properties of Ti-Mo Alloys Containing Noble Metals, by C. R. Bishop, Union Carbide Metals Co., Niagara Falls, N.Y., and Milton Stern, Linde Co., Indianapolis, Ind.

Investigation of the Effects of Fabrication Variables on Corrosion Resistance of Zircaloy-2, by Herbert S. Kalish, Nuclear Fuel Research Laboratory, and Harold M. Cobb, Olin Mathieson Chemical Corp., New Haven, Conn.

Propagation of Stress-Corrosion Cracking in a Magnesium-Base Alloy as Determined by Several Techniques, by W. M. Pardue, Battelle Memorial Institute, Columbus, Ohio, and F. H. Beck and M. G. Fontana, Ohio State University, Columbus.

Diffusion and Transport of Carbon in Ferrous Metals

William A. Pennington, National President ASM and professor of metallurgy at the University of Maryland, in a speech on "Diffusion and Transport of Carbon in Ferrous Metals" at **Detroit,** covered the subject from the viewpoint of the mechanism of decarburization, the thermodynamics involved in decarburizing steel with mill scale and the graphitization of white cast iron to produce malleable iron.

Carbon is pictured as moving by two mechanisms. One of these is the ordinary diffusion caused by the random motion of carbon atoms. The other is caused by a "pumping action" wherein the carbon is pumped much like oil or water might be pumped through pipes.

It is necessary for two phases to be present to have the transport caused by the pumping action. The pumping energy is developed from the latent heat of transformation as the one phase rich in carbon is converted to one less rich in carbon.

The mechanism of decarburization was developed through experimentation involving the decarburization of eutectoid steel using temperatures from 1275-1700°F. Hydrogen containing about 20% by volume of water vapor was used as the decarburizing medium. The hydrogen served as a deoxidizing agent to prevent the formation of oxides on the metal surface. Thus water vapor, the decarburizing substance, had free access to the surface where it reacted with dissolved carbon to produce carbon monoxide.

At 1275°F., the reaction within the metal is one of simple diffusion, but within the critical range, as long as the temperature is as high as 1400°F., an alpha iron case forms on eutectoid steel within a very short time after the decarburization is started. Thinking of the cross section of the steel sheet one would visualize a sandwich at the operating temperature of austenite between two layers of ferrite. The carbon content just inside the austenite band, but adjacent to the ferrite band, is that required by the A_3 line of the iron-carbon equilibrium diagram; that nearby in the ferrite band is governed by the ferrite line in the diagram.

If decarburization of eutectoid steel containing 0.83% carbon is carried out at 1500°F., the austenite containing 0.32% carbon will be adjacent to ferrite containing 0.015% carbon. At 1640°F. the corresponding values are about 0.005 and 0.00025% carbon. In experiments involving sheet steel 0.064 in. thick, it was found that the carbon was removed in about the same length of time regardless of the temperature as long as the temperature was as high as 1450°F. The carbon literally "pours through" the ferrite at 1640° even though the ferrite contains no more than about 0.00025% carbon.

The mechanism as reported would call for a transformation of a colony of atoms from austenite to ferrite at one time rather than a simple atom diffusion phenomenon. Once the colony started the transformation, it would contain about 20 times as much carbon as can be retained in ferrite at the same temperature. Hence the chemical activity would be 20 times that of ferrite with the composition governed by the ferrite line.

There was no ferrite banding either below or above the alpha-gamma transformation range. Ferrite banding does take place all the way from the eutectoid temperature up to the A_3 point for pure iron. Apparently, however, the austenite transformation to ferrite is not fast enough at 1350°F. to prevent the formation of ferrite islands back in the center band. In other words, the center band for this temperature is not all austenite as it is for the higher temperatures. The transfer area between the two phases must be increased over the straight-edge area.

In the second area of investigations low-carbon steel (about 0.06% carbon) was decarburized by mill scale to develop a commercial method for producing a product with about 0.005 or 0.006% carbon. The main purpose was to produce an extra soft product so that the steel would not regain certain stiffness that might be imparted to the original product were it heated to 1500°F. and cooled as is done in normalizing.

This problem was solved through the help of chemical thermodynamics. It was demonstrated in the lecture how one may get equilibrium constants for the deoxidizing and decarburizing reactions and then with these data calculate the end-point carbon for a given situation. It was pointed out that the carbon content at say 0.042% carbon is not low enough to get the desired softness; it must be in the vicinity of 0.007 or lower. When the carbon is removed to such a low level large grains are formed.

Calculations were given to indicate that decarburization with mill scale could be stopped by increasing the total pressure of CO and CO_2 to something like 35 psia. Decarburization is also stopped, even where moist hydrogen is used, by 0.0001 in. of copper plate.

If the end-point carbon is too high to be practical, say, around 0.012%, it can be reduced still further by flushing out the annealing cover or furnace with nitrogen or any other inert gas.

The transport of carbon from austenite to graphite in the direct second stage of graphitization, obtained by cooling slowly from 1650° after all free cementite had been decomposed, is affected tremendously by the number of nuclei.

A sample containing 760 nuclei per cu. mm. had 85% pearlite after cooling at 300° per hr.; 50% after cooling at 100° per hr. One with 100,000 nuclei had only 6% pearlite for the faster rate of cooling.

The direct second stage of graphitization was virtually nonexistent if the manganese content was lower than the stoichiometric amount to react with the sulphur present. In other words, even with a very slow cooling rate, there would be almost 100% pearlite surrounding the graphite.

The indirect second stage graphitization is carried out by reheating to some 1200°F. material which has been cooled at a fairly high rate from 1650°F. It is the result of direct decomposition of pearlite rather than austenite. The nodule number had slight effect as contrasted to the pronounced effect on direct second stage graphitization.

The number of nuclei has such a tremendous effect that one must take it into consideration and correct results to the same number in order to understand other effects such as that of the presence of trace elements.

Materials—
the Challenge of the Sixties

W. R. Hibbard, Jr.

W. R. Hibbard, Jr.

This symposium* on materials is organized according to conventional categories—metals, ceramics, glass and polymers. I predict that by 1970, it will be oriented to uses—structural, magnetic and electrical, optical and nuclear, as examples. There are at least three reasons for predicting this change:

First, the fundamental principles of the behavior of materials, their characteristics and properties, are independent of these conventional categories. Thus, a ceramic may be transparent like a glass. In fact, several types of materials other than conventional oxides can be made into the supercooled glassy state, including metals. The Griffith crack theory developed for glass applies equally well to metals, ceramics and polymers. Deformation by slip occurs in ceramics, metals and certain crystalline polymers.

New Environmental Problems

The second reason stems from the fact that the competitive industrial situation is changing. For many years, materials as they were developed, manufactured and marketed by the producer were suitable for most applications. This is no longer true. The 8-10% improvements in properties which will occur evolutionarily from producer-paced research are no longer meeting consumer needs. Larger revolutionary changes are needed to survive in new and unique environments and to meet other requirements. These needs cannot be limited by the provincial viewpoint of a single category of materials.

In the past decade or two, there has appeared a large amount of consumer-financed research. The largest consumer is the government, which, through the Department of Defense, the Atomic Energy Commission and the National Space Agency, supports materials research and development totaling something around a quarter of a billion dollars a year. These activities have included the establishment of materials science centers at several universities.

Key to Competitive Leadership

Finally, in many industries, electronics, for example, the uniqueness of products (and thus competitive leadership) may depend on the uniqueness of materials for special applications. Thus, many user companies are deeply involved in materials research and development, not from the standpoint of material category, but from the standpoint of use.

Take, for example, the nuclear reactor for power production. Among the limitations of this device is the material used for jacketing the fuel elements. If a material was available that would operate at increased temperatures without corroding in the cooling medium, nuclear power stations of appreciably greater efficiency and, hence, greater economy would be possible.

A materials-limited problem familiar to all of us is the nose reentry problem for missiles and space vehicles.

We are not satisfied with present refrigerators, and because of improvements in materials, it should soon be possible to produce a practical refrigerator, using the thermoelectric principle, which will be more convenient than your present refrigerator.

Diamonds are now made synthetically. This foreshadows a much wider use of diamond abrasives and consequent cost reduction in the manufacture of countless articles of commerce.

The locomotive symbolizes transportation, not only by rail but by other means as well, where innovations in materials will bring about major changes in the future. Someday the locomotive, and possibly the automobile, may operate from a silent and efficient fuel cell instead of making use of the noisy and relatively inefficient internal combustion engine. All that prevents the economical application of the fuel cell today is that materials which are adequate are not known.

In radar and communications, materials innovations are taking the form of deceptively simple crystals of carefully controlled impurity, we may have either a transistor or solid state electron tube or we may have a maser (a device for producing a coherent beam of electromagnetic radiation of tremendous intensity) capable of being used as a light source or as a communication medium, since it possesses enormous band width. Or perhaps the material might take the form of a tiny electronic circuit completely assembled by the evaporation of a series of extremely thin films of different materials.

Problems of Everyday Materials

We have not only the completely new and revolutionary applications

*These remarks were made by Dr. Hibbard at a Symposium on "Materials of Engineering" sponsored by the College of Engineering, University of Rochester and the Rochester Chapter ASM.

of materials, but we still have left materials application problems concerned with continual refinement leading to an incremental improvement in the performance of a product. An example of this would be the development of a new insulation system for a motor. An insulation system capable of operation at higher voltages and temperatures will lead to a motor of reduced size and increased performance. Possibly the materials innovation, when it occurs, may take the form simply of a reduction in cost, as in the instance of diamonds previously noted, or a new method of producing some basic material or form of material such as conductor cable. All of these aspects of materials innovations and utilization are important.

More Effective Communication

Increasingly large sums of money are being spent on research and development. In this country, fundamental science largely has been carried out in universities. The several-fold increase in government spending on materials research includes large sums for universities to work in areas of fundamental science. In a sense, these universities are the government's fundamental research laboratories and are their source of new scientists and new science.

The results of these researches traditionally have been pubiished in the open literature, available to all who subscribe. There appears to be a need for an effective mechanism for bringing the results of this science promptly to bear directly on our national problems faster, for example, than our competition can act through the open literature. This, in my opinion, is the challenge of the sixties.

Richmond Series on Corrosion of Metals

In the first of a series of lectures sponsored by the **Richmond** Chapter on "Corrosion of Metals" Henry Leidheiser, director, Virginia Institute of Scientific Research, set the stage for other experts—specialists on corrosion of steel, copper, aluminum and other alloys.

Dr. Leidheiser dealt with corrosion of metals in gaseous media and the more familiar electrochemical corrosion of metals in an electrolyte. In studying corrosion, one must look at the rate at which a metal is converted from one state to another. In some uses, it is important to have no corrosion whatever, as in the use of metals in body surgery; while on the other hand, high rates of oxidation are important when considering metals for use in explosives or rocket fuels.

New uses and properties of metals can be uncovered by the application of principles discovered in basic corrosion studies. A case in point is the alloying of titanium with small quantities of various noble metals, such as palladium and platinum, to produce alloys of considerably more corrosion resistance than any previous titanium alloy.

Iron and Steel

The second lecture, by John F. Eckel, head, department of metallurgical engineering, Virginia Polytechnic Institute, was on "Effects of Composition and Environment on Corrosion of Iron and Steel".

Corrosion is a natural process in which a metal seeks a lower energy state by forming an oxide, a sulphide or other compound. The important variables in the study of corrosion—which is primarily a rate study—may be divided into two classes: internal variables (those having to do with the metal), and external variables (those having to do with the environment). For iron and steel, composition and surface condition—both of which affect electrode potential—are the important internal variables. Corrosion resistance is independent of method of fabrication. Considering atmospheric exposure only, the primary external variables are type and amount of air contaminants, temperature, humidity and rainfall.

Nature of Films. In order for a film to be protective, it must be impervious to the corrosive medium or anodic to the base metal. The

Shown are the speakers at the Rochester Symposium on "Advances in Engineering Materials", from left: William B. Crandall, Alfred University, who covered "Ceramics", Allen G. Gray, editor, Metal Progress, *who discussed "Metals Technology in the Sixties", George W. McLellan, Corning Glass Works, who described "Properties and Uses of Glass", Walter R. Hibbard, Jr., General Electric Co., whose talk on "Materials—the Challenge of the Sixties" is reported on p. 11, Richard E. Eisenberg, University of Rochester, Symposium chairman, Burton S. Payne, technical chairman, and Russell Brush, chairman*

volume of film formed must be about equal to the volume of metal reacting to form the film. If film volume is larger, it will spall; if smaller, the film will have discontinuities.

A metallic coating can protect a metal surface by being anodic to the base metal or by completely coating the metal object (even with a cathodic metal), thus effectively polarizing the base metal. Painted surfaces must be impervious to the corrosive medium or an oxygen concentration cell may be set up beneath the paint and the metal will corrode.

Atmospheres. Atmospheres may be industrial, marine or rural, but the atmosphere may vary greatly from one test site to another within any classification. Sulphur dioxide (industrial) and chloride ions (marine) have a deleterious effect on iron and steels.

Generally, additions of copper, nickel, chromium, silicon and phosphorus increase atmospheric corrosion resistance of steels. The effect of an addition will vary depending upon atmosphere. The addition of any one element may not improve corrosion resistance to any great extent but the addition of a combination of elements may make a very great improvement. Additions that give good corrosion resistance in an indutrial atmosphere may not give good resistance in a marine atmosphere.

Copper and Copper Alloys

In a discussion on the corrosion resistance of copper and its alloys, V. F. Nole, Chase Brass and Copper Co., pointed out the various types of corrosion which copper alloys resist and indicated how corrosion is minimized by the proper selection of materials.

The resistance of copper to atmospheric corrosion is explained by the formation of an oxide coating and copper basic sulphate, the green patina.

Copper also offers resistance to naturally occurring waters, dilute mineral and organic acid and saline solutions, the rate of attack depending on the amount of oxidizers in the solution. Ammonia-bearing compounds in the presence of moisture, oxygen and CO_2 are especially harmful to most alloys, as are mercury and mercury compounds. However, alloys of copper have been developed to suit most environmental conditions. The selection of proper alloy must be made carefully with the aid of service experience, laboratory tests and exposure in service, with due regard for cost.

Copper alloys corrode by most of the common corrosion mechanisms including chemical attack, galvanic action, oxygen concentration cell and dezincification. Corrosion is often accelerated by stress, fatigue and impingement, but with proper alloy selection service life can be controlled.

Of the entire copper-zinc series of alloys, the best general resistance to corrosion by aqueous solutions is obtained with red brass containing 15% zinc. Brasses containing over 20% zinc are especially susceptible to dezincification and stress corrosion, but brasses with the higher zinc contents are most resistant to sulphur corrosion.

Copper-nickel alloys with up to 30% nickel are highly resistant to impingement corrosion, stress corrosion cracking and acid attack but are unpredictable in sulphur-bearing environments.

The phosphor bronze alloys with up to 10% Sn and 0.25% P are, in general, comparable to copper in regard to general corrosion resistance. However, tin appears to improve the resistance to acid attack. Silicon, used in amounts up to 3%, also improves resistance to acid.

Aluminum and Its Alloys

The increased use of aluminum is due not only to its light weight and ease of fabrication but because of good corrosion resistance.

H. Lee Craig, Jr., Reynolds Metals Co., covered three general areas in his lecture: cast and wrought alloys, types of corrosion and methods of protection.

There are only a few alloying agents that have an adverse effect on the corrosion resistance of aluminum. Iron, magnesium, silicon, zinc and manganese, found in wrought alloys, have slight effect on corrosion resistance. But copper, even in small amounts, will greatly lower corrosion resistance and, as the copper content increases, the corrosion rate increases proportionally. The three major classes of cast aluminum alloys—silicon, copper and magnesium—have corrosion characteristics similar to that of the wrought alloys.

Types of Corrosion. There are four general types of corrosion that aluminum alloys may exhibit: (1) uniform, in which the entire surface is attacked; (2) pitting, in which attack is in small localized areas producing deep pits; (3) intergranular, in which attack is along grain boundaries; and (4) mechanical working plus a corrosion environment, in which metal fatigue, fretting and erosion takes place.

Methods used to protect aluminum and its alloys include electrochemical surface treatments and inhibitors, sacrificial claddings, applied current cathodic protection, chemical conversion coatings, organic coatings and plating.

THE PHILADELPHIA CHAPTER *selected Norman Mochel, manager, metallurgical engineering, Westinghouse Electric Corp., as its Delaware Valley Metals Man of the Year in recognition of his metallurgical accomplishments, his ability as an executive in the metals industry, his untiring and unselfish efforts in behalf of the Chapter, the Society and the profession, and for having the characteristics ASM members prefer and admire in their executives. Mr. Mochel, center, is shown with Chairman J. B. Giacobbe, left, and Amos Bradd, Awards Committee chairman*

CHAPTER BRIEFS

• National Trustee Albert Fairchild filled members of the **Birmingham** Chapter in on national headquarters activities as coffee speaker at a recent meeting.

• Some 120 members and wives witnessed a special presentation of "Tobacco Road", produced and put on by the **Warren** Chapter for the Ladies Night Meeting.

• Several methods of sample preparation and the techniques involved were reviewed by Raymond F. McCartney, U. S. Steel Co., in a talk on "Electron Metallography of Steel" at a **Northeast Pennsylvania** Chapter meeting.

• Data indicating that columbium additions in carbon steels result in better weldability for materials having strengths equal to those of other higher carbon proprietory steels was presented at a **Calumet** meeting by F. E. Van Voris, metallurgical engineer, Union Carbide Metals Co. Also, he stated, with proper heat treatment, improved impact properties can be obtained with little reduction in strength.

• The continuous casting process, although not utilized to a great extent by the United States steel industry, is being used for aluminum, magnesium, lead and other metals. Numerous processes and new methods are being developed and used at an ever-increasing pace, according to Carl E. Swartz, vice-president ASM and consulting engineer, Hinsdale, Ill., at a talk given before the **Peoria** Chapter.

• About 30 members of the **Terre Haute** Chapter recently enjoyed an interesting and informative tour of the American-Wheating Glass Corp.'s plant.

• The **Jackson** (Michigan) Chapter's panel of "experts" who answered questions on furnace alloys included Charles H. Emery, sales manager, Simonds Saw and Steel Co., John J. Moran, in charge of high-temperature engineering, Development and Research Dept., International Nickel Co., Hugh C. Webb, district manager, Central District, Haynes Stellite Co., and A. L. McMasters, vice-president of sales and engineering, Michigan Standard Alloy Casting Co. Joe Harrison of Fab-Alloy Co. moderated.

• **Milwaukee's** first annual high-school student night dinner included talks on "What Is Metallurgy", by Marvin Evans, metallurgical consultant, "The Role of the Research and Development Metallurgist", by Walter Edens, assistant to research head, Allis-Chalmers Manufacturing Co., "The Role of the Plant Metallurgist", by Elmer Gammeter, head of the metallurgical department, Babcock & Wilcox, "The Role of the Sales Metallurgist", by R. C. Onan, president of Waukee Engineering Co., "What the University of Wisconsin Has to Offer", by Phil Rosenthal, head of the mining and metallurgy department, "What Marquette University Has to Offer", by Louis F. Sander, associate professor, and "What Milwaukee School of Engineering Has to Offer", by Ed Meier, head of the department of metals and metallurgy.

NEW BOOKS

Atomic Theory for Students of Metallurgy, 3rd Revised Edition. William Hume-Rothery. Institute of Metals, 17 Belgrave Sq., London, S.W. 1, England. ($7.50)

The Chemical Formulary, v. 11. H. Bennett, Editor-in-Chief. Chemical Publishing Co., 212 Fifth Ave., New York 10, N. Y. ($8)

Dictionnaier de Metallurgie. O. Bader and M. Theret. Editions Eyrolles, 60, Blvd. St.-Germain, Paris, 5e, France.

Full Scale Fatigue Testing of Aircraft Structures. F. J. Plantema and J. Schijve, Editors. Pergamon Press Inc., 122 E. 55th St., New York 22, N. Y. ($15)

Handbook of Thermophysical Properties of Solid Materials,

Montreal to Offer Seminar on Materials Selection

On Sept. 14-15, 1961, the **Montreal** Chapter will hold its first two-day seminar. The subject to be discussed will be "Selecting the Right Material for the Job".

A $15 attendance fee, which will include some meals, will be charged.

The proposed program is as follows:

PROGRAM (Tentative)
TWO-DAY FORUM—MONTREAL CHAPTER ASM
"SELECTING the RIGHT MATERIALS FOR THE JOB"
Sept. 14-15—Ecole Polytechnique

Sept. 14

"Welcome"	A. Scully—Chapter Chairman
Keynote Speech*	R. M. MacDonald — Steel Co. of Canada Ltd.
"The Application of Carbon and Alloy Steels for Industry"	G. E. Willey, Metals Div., Union Carbide & Carbon Corp.
Lunch	Dave Boyd—Rolls-Royce of Canada Ltd.
"Steels—Corrosion and Heat Resistant"	G. Farnham—International Nickel Co. of Canada Ltd.
"Tool and Die Steel Selection"	Bruce Hamilton—Atlas Steels Ltd.
Dinner	John Convey—Dept. of Mines & Technical Surveys, Ottawa.

Sept. 15

"High-Strength Specialty Nickel Alloys"	K. Young—International Nickel Co. of Canada Ltd.
Copper Alloys*	C. L. Bulow—Bridgeport Brass.
Lunch*	Thank-you talk—speaker to be selected.
"The Many Strengths of Aluminum"	C. Marsh—Aluminum Co. of Canada Ltd.
The Newer Metals (Ti, Zr, Ta, Mo)*	Ray Quadt—Reactive Metals Inc.

*Titles of these talks not yet specified by speakers.

v. 1, **Elements (Melting Temperatures Above 1000° F.)** Revised Edition. A. Goldsmith, T. E. Waterman and H. J. Hirschhorn, Editors. Pergamon Press, 122 E. 55th St., New York 22, N. Y. ($30)

Industrial Furnaces, v. 1, 5th Edition. W. Trinks and Matthew Mawhinney. John Wiley and Sons, Inc., 440 Park Ave., S., New York 16, N. Y. ($17)

Iron and Steel Institute, Journal, v. 68, 1960-1961. West of Scotland Iron and Steel Institute, 39 Elmbank Crescent, Glasgow, C.2, Scotland.

Physical Chemical of Process Metallgury, Parts 1-2. Metallurgical Society Conference, v. 7-8. George R. St. Pierre, Editor. Interscience Publishers, 250 Fifth Ave., New York 1, N. Y. ($22.50 and $25)

Powder Metallurgy. Werner Leszynski, Editor. Interscience Publishers, 250 Fifth Ave., New York

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Practical Aspects of Hardenability

Hardenability plays an important role in the selection of steels for many applications. At a recent meeting of the **Chicago** Chapter, George K. Manning, technical manager, Battelle Memorial Institute, discussed this subject in some detail. He correlated test results and hardness gradients in quenched rounds, with special regard for shallow hardening steels that are being used for induction and flame hardened parts. He also discussed the carbon steel hardenability bands being established by SAE and how they may help the consumer.

Hardenability can be measured by either of two standardized tests: the Jominy end quench test, in which a heated 1-in. round bar is water quenched on the end, and the SAC (surface, area, center) test, in which a standard 1-in. round is submerged quenched in water. A SAE steel committee on hardenability has concluded that either the end quench or SAC test may be used for shallow hardening steels; for deeper hardening steels the end quench test is required.

Hardenability is dependent upon transformation rates, shown by TTT curves which, in turn, are determined by the chemical composition of the steel—the greater the alloy content, the greater the hardenability. The hardness pattern in a finished part is controlled not only by hardenability but also by the surface to mass ratio and of the part, and by the quenching conditions (brine, water or oil).

Carbon has a dual role in controlling maximum hardness as well as influencing hardenability. Maximum carbon content is frequently limited by the likelihood of quench cracks, hence it usually cannot be used as a means of controlling hardenability. There is usually an economic advantage in using relatively small additions of several alloy elements to achieve the desired hardenability rather than a large addition of a single alloying element.

The AISI and SAE have published hardenability bands for many alloy steels and will very shortly publish bands for two carbon steels. An evaluation of these charts, together with a few tests, will allow selection of the most economical steel needed for a certain application. *(Reported by W. L. Meinhart)*

G. K. Manning, Battelle Memorial Institute, G. L. Hansen, technical chairman, and J. H. Greenberg, chairman, shown at a meeting of the Chicago Chapter

WINNER OF AWS DISTRICT MERITORIOUS AWARD—*Irving A. Oehler, right, president, American Welding & Manufacturing Co., accepts award from R. D. Thomas, national president of the American Welding Society and president of Arcos Corp. Dr. Oehler, well known as a specialist in flash welding of exotic metals, was honored for his long-standing record of contributions to the advancement of welding*

Metallurgy and Management

The metallurgist's part in the decisions made by management in the development of the low iron-bearing taconite ores of the Lake Superior Region has been important to the steel industry and to the nation, George H. Todd, assistant manager of the Ashland Works, Armco Steel Corp., told members of the **Penn State** Chapter in his David Ford McFarland Award for Achievement in Metallurgy lecture.

Mr. Todd reviewed the developments which started in 1930 under the direction of Ed Davis, professor at Minnesota University, who developed a satisfactory laboratory method of separating the magnetite crystals from the accompanying silica gangue. He pointed out that the subsequent improvement in pelletizing technique by reducing the silica content and by increasing the stability of the pellet was a tremendous metallurgical accomplishment. Taconite pellets were changed from merely an iron enriched blast furnace charge to a product which provides the full advantage of the ideal blast furnace burden (i.e., one of uniformity of size and spherical in shape). Results on the use of an essentially all-pellet burden when compared to 90% Lake ores and 40% pellet burden in 1954 were:

1. Average production increased to 2500 tons per day in 1960, a gain of 84%.
2. A coke rate of 1187 lb. per ton in 1960 is a reduction in coke consumption of 30% since 1954.
3. A 30% increase in the rate of wind blown.
4. Despite an increase of wind of 20% in 1959, dust per ton of iron produced at 200 lb. has been reduced by 55%.

Mr. Todd explained that it is reasonable to assume that in 1981, 40.6% of the iron ore consumed in the U.S. will be taconite pellets.

The all-pellet burden fits perfectly into all other programs for improved performance of the blast furnace, in economy and increased production, which are now receiving attention throughout the industry as the result of generally improved burdens. It is reasonable to believe that blast furnaces of 32-34 ft. hearth diameter will report average daily production rates of 4,000 tons at coke rates as low as 700 lb. per ton by the late 1960's.

The David Ford McFarland Award was established in 1949 by the Penn State Chapter as an annual recognition to a metallurgy alumnus of the University. Mr. Todd's selection was based on his success in the metals industry and his record as a citizen. Martin Brezin, chairman of the Awards Committee, presented the certificate of recognition to Mr. Todd, who received his B.S. degree in metallurgy at Penn State in 1928, where he studied under the guidance of the late Dr. McFarland. Mr. Todd is the 13th recipient of the annual award.

George H. Todd, *Armco Steel Corp., holds the certificate honoring him as the 13th recipient of the David Ford McFarland Award of the Penn State Chapter. Martin Brezin, left, chairman of the Award Committee, made the presentation. William A. Pennington, right, ASM national president, spoke briefly at the banquet meeting, after which Mr. Todd delivered the Award address, "Metallurgy and Management"*

Engineering Aspects of Brittle Fracture

The study of brittle fracture has been so active during the past 20 years that perhaps even more important than wondering what is new, it may now be more appropriate to review and examine the known factors which influence fracture and over which metallurgists now have some control. These factors were the interesting subject of Robert D. Stout, dean of the graduate school, Lehigh University, who spoke before the **Wilmington** Chapter on "Engineering Aspects of Brittle Fracture".

There are a number of engineering tests used in fracture studies and, unfortunately, the fracture criteria of these tests are not always related to each other inasmuch as each test measures a different property or combination of properties. Experience has taught that tests which use either ductility or the amount of absorbed energy as fracture criteria are extremely sensitive to geometrical changes. Dr. Stout pointed out that the appearance of the fracture (i.e., whether it is fibrous or crystalline) has proven to be rather insensitive to geometry. He also pointed out that since plastic deformation raises the ductile-to-brittle transition temperature, tests which may allow deformation require recognition of this phenomena.

Alloying elements which dissolve substitutionally in iron have only a mild influence on the ductile-to-brittle transition temperature while those which dissolve interstitially have a pronounced effect. Only nickel and manganese have been found to lower the transition temperature of iron. Alloying affects the transition temperature of ferrite indirectly by its influence on grain and subgrain size. In pearlite steels of eutectic composition, the ductile-to-brittle transition tem-

perature increases with decreasing spacing of the lamella. Low-carbon steels containing both ferrite and pearlite generally develop microcracks at the grain boundary or at the pearlite-ferrite interface and the crack propagates through the ferrite, not the pearlite. It is believed that this is so because the ferrite has been placed in restraint by the presence of the pearlite.

The toughness of low-carbon steels can be improved by rapid cooling followed by a tempering step. This discovery has made it possible to chose between alloying and heat treatment for the most economical avenue to tougher steels.

Dr. Stout concluded by stressing the need for an expanding program to better understand the phenomena of brittle fracture. *(Reported by G. D. Smith)*

Iron Ore Reduction

"Direct Reduction of Iron Ore" was the subject of a talk presented before the **Washington** Chapter by Dwight C. Brown, assistant director of research, Graham Research Laboratories, Jones & Laughlin Steel Corp.

The direct reduction process in the past has been defined as one in which iron oxides are reduced without melting. Currently, it can be defined as including any process for reducing oxides of iron using equipment other than the blast furnace. With the exception of the Krupp-Renn process and certain electric furnace processes, in which melting of the product occurs, all other processes are carried out at temperatures below the fusion point of iron. Direct reduction processes can be adapted to perform functions of beneficiation, agglomeration and reduction. Partial reduction is also used in conjunction with the electric furnace. The principal advantages of direct reduction can be summarized as: lower cost route to hot metal than blast furnace in certain cases; smaller minimum economic size plants; preferred means of beneficiating certain lean ores; adaptable to areas with ore and oil and gas but no metallurgical coke; and advantage taken of fine size consist of concentrates for ease of handling and reduction.

Economic considerations have limited commercialization of direct reduction to a large extent. Of the several plants in operation abroad, there are several in Sweden using the Wiberg Soderfors and the Hoganas processes. There are many installations in Europe, Russia and Asia using the Krupp-Renn process. Plants operating in this country include the H-Iron plants at Conshohocken, Pa., and Los Angeles. These plants reduce ore in a vertical four-zone reaction vessel. There are also facilities for producing hydrogen. In the reduction vessel, ore is in contact with hydrogen gas at a temperature of 1000°F. and at a pressure of 500 psi. The low temperature prevents the iron particles from sticking to the vessel and from sintering together. The high pressure increases the rate of reduction by improving the contact between the gas and the ground ore. Safety precautions at a plant using high-pressure hydrogen are about the same as those taken at an oil refinery.

Most of the reduction plants in operation process ore in rotating kilns. The Hoganas plant in Sweden has a ring-shaped ceramic kiln about 900 ft. long, which operates at 2100°F. during an 80-hr. cycle. This particular plant is one of the most efficient in heat economy as only 14 million BTU's are required per ton of sponge. The 200 ton per day HyL plant processes ore using five retorts that are constantly in motion, one being dumped each hour, and operates at 17-21 million BTU per ton. Iron oxide reduced above 1500°F. is relatively inert when cooled and exposed to air. Fine concentrates reduced to metallic iron at temperatures below 1300°F. tend to be pyrophoric even after careful cooling and to reoxidize on exposure to air. Pyrophoric iron, however, can be passivated by heating to 1500°F. in an inert atmosphere.

As the technology of direct reduction processes continues to advance, it is conceivable that in the near future the direct reduction process will find its place in the integrated steel plant complex. *(Reported by Robert E. Lyons)*

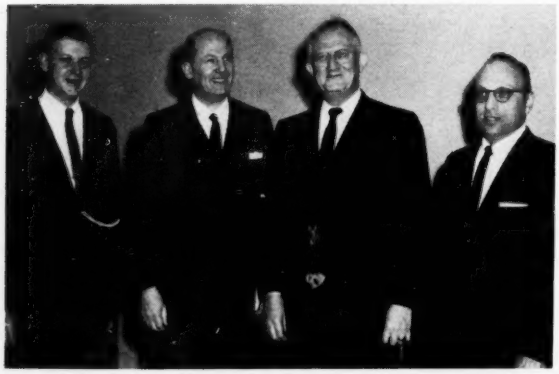
Direct Reduction of Iron Ore was explained at a Washington Chapter meeting by Dwight C. Brown, Jones & Laughlin Steel Corp. Pictured are: Richard Raring, chairman; Mr. Brown; Mason Larwood, chairman, membership committee; and M. L. Williams

C. W. ALLEN, LEFT, SECRETARY *of the Notre Dame Chapter, looks on while G. C. Kuczynski, department of metallurgical engineering at Notre Dame, listens to a comment about "Future High-Temperature Materials", which was the subject of a talk by Ray W. Guard, General Electric Co. James Beaton, chairman, looks on*

Chapter Prints

Winners of Philadelphia's Student Metallographic Contest held in conjunction with the annual Students' Night Meeting are, from left: Robert Griggs, ASM-Temple Evening Metallurgy Course, James Anson, Temple Evening Course, and J. De Maris, Drexel Institute of Technology. John Frome, right, made the presentation of the prizes in behalf of the Educational Committee

Nicholas J. Grant, professor of metallurgy at MIT, is shown receiving Philadelphia Chapter's citation for "notable contributions to metallurgical education" at the Students' Night Meeting. The award was presented by Harry N. Ghenn, chairman, left. Dr. Grant, recently returned from a trip to Russia, gave a talk entitled "A Third Look at Russian Technology"



National Officers Night at Boston featured a talk on "Diffusion and Transport of Carbon in Ferrous Metals" by ASM National President William A. Pennington. Shown, from left: W. H. McCarty, chairman, Morris Cohen, national trustee and technical chairman, Dr. Pennington, and S. G. Demirjian, program chairman

Sustaining members of the Rochester Chapter are shown during a meeting during which Ralph Boynik, principal of Edison Technical and Industrial High School, and Anton deS. Brasunas, director, ASM's Metals Engineering Institute, spoke on education. Dr. Brasuncs presented certificates to 18 graduates of the MEI course on Toolsteels and 32 to graduates of the Chapter's course on Applied Metallurgy

MEN in METALS

A. R. Fairchild, ASM national trustee, was elected president of the Winston-Salem Engineers Club at a meeting held at the Weeks Div. of Hanes Hosiery Mills Co. Fairchild, head of the manufacturing development engineering department and a metallurgist at Western Electric Co., is a native of Spokane, Wash.

Other new officers are: M. C. Crotts of Crotts and Sanders Engineering, vice-president; R. C. Snook of Bell Telephone Laboratories, secretary; H. D. Bolick, superintendent of building and grounds for the City of Winston-Salem, treasurer.

A National Science Foundation post-doctoral fellowship has been awarded David E. Soule, research physicist at the research laboratory, National Carbon Co. Dr. Soule will study electronic size effects in metals at low temperatures at the Royal Society Mond Laboratory, Cambridge University, England.

The Alvey-Ferguson Co. has appointed Stanford J. Barlett manager of its Industrial Cleaning and Finishing Equipment Div.

C. G. Andrew, vice-president production-distribution for Air Reduction Sales Co., was named president of the International Acetylene Association at its 63rd anniversary meeting, recently held in Boston. Mr. Andrew has been associated with Airco since 1923.

Oliver E. Accountius has joined the Research Dept. of Rocketdyne, a division of North American Aviation, Inc., as senior technical specialist in ceramics in the Materials Research Section. He will research refractory and composite inorganic materials associated with advanced rocket engine requirements. He was previously section head of Inorganic Synthesis at Aerojet General Corp.

Fred W. Beitner has been appointed vice-president, sales, of Trent Tube Co., a subsidiary of Crucible Steel Co. of America. He joined the sales department in 1946 and for the past 15 years has been a sales engineer, district sales manager in New York City, and general sales manager of the company.

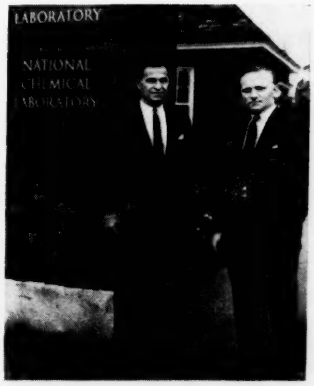
Charles T. Blake, director of engineering, Warner & Swasey Co., has been elected 1961-1962 president of the Cleveland Engineering Society.

Robert W. Brady, formerly sales manager of power tools and steel tape rules, has been appointed product sales manager of the Disston Div., H. K. Porter Co., Inc.

Alfred H. Cordes, Jr., Lytton A. Kendall, Jr., and Robert F. Zimmerman have been named application engineers to Allis-Chalmers processing machinery department. Both Cordes and Kendall have been assigned to cement machinery sales, Zimmerman to the company's minerals processing group.

Carl S. Hallauer, chairman of the board, Bausch & Lomb Inc., has been named recipient of the Scientific Apparatus Makers Association Award in recognition of his "leadership, accomplishments and service to the industry, to the progress of science and to the strength of the country".

Bernarr E. Hopkins, leading British metallurgist and 1957 recipient of the Sir George Beilby Memorial Award, has been named Ohio State University's first Battelle Professor of Metallurgy. Currently senior principal scientific officer at the National Physical Laboratory, Teddington, England, Hopkins will fill the new chair during the 1961-1962 academic year. The new professorship was established by Battelle Memorial Institute, Columbus, to "enhance and enrich the scientific foundations of instruction and research". It carries a stipend of $15,000 per academic year and provides that an expert in different fields of metallurgy be appointed each year.



Bernarr E. Hopkins (right) discusses his Battelle Professorship with Mars G. Fontana, chairman of Ohio State's department of metallurgical engineering

Loren K. Hutchinson has been promoted to manager of operations for the Eastern Div. of Wyman-Gordon Co., Worcester, Mass. He was formerly works manager at the Worcester plant.

W. Arthur Irvine, manager of production engineering of the Maytag Co., Newton, Iowa, has been elected president of the Metal Powder Industries Federation, succeeding George A. Roberts, vice-president of Vanadium-Alloys Steel Co. (ASM past president). Kempton H. Roll, executive secretary and treasurer of the Federation since 1956, was reappointed to this capacity by the Board of Governors. The trade associations comprising the Federation elected the following officers: Robert C. Burgess, vice-president of Burgess-Norton Manufacturing Co., was elected president of the Powder Metallurgy Parts Manufacturers Association; Earl Lowe, president of Greenback Industries, Inc., was elected president of the Metal Powder Producers Association; Peter V. Schneider, head of International Business Machines Corp.'s powder metallurgy department, was re-elected president of the In-Plant Powder Metallurgy Association; Norbert K. Koebel, director of research of Lindberg Engineering Co., was re-elected president of the Powder Metallurgy Equipment Association; John C. Webb, president of the Magnetic Core Corp., was elected president of the Metal Powder Core Association.

Obituaries

Donald Eugene Wilson, 63, died Sunday, May 28, in a Houston hospital. A native of Hendrick, Ind., he had lived in Houston for 13 years where he was employed as a metallurgical engineer with Cameron Iron Works, Inc. "Doc" served as chairman of both the Calumet and Houston Chapters ASM.

John M. Lessells, Lessells and Associates, Inc., Boston, Mass., passed away May 17 after a brief illness.

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SALES ENGINEER: Investment casting, must have mechanical background and/or foundry knowledge. Sales experience desirable. Considerable phone and personal customer contact. Based at plant, but moderate travel expected. Usual company benefits. Salary commensurate with ability and experience. Please submit complete resume. All replies confidential. Box 7-10.

HEAT TREATER: Production, take charge. Operate production shaker hearth furnaces, automatic tempering. Atmosphere control, must be familiar with endothermic generators. State experience and salary expectations. Box 7-15.

METALLURGIST: To supervise operation of heat treating plant. Commercial heat treating experience desirable. Applicant will have opportunity to participate in management policies of business. Send resume and salary requirements. Box 7-20.

SALESMAN/MANUFACTURERS REPRESENTATIVE: Metal removing and forming compounds for all metals, but especially for stainless and exotic metals. Established company expansion. Age no barrier. Knowledge of machine tool and press operations helpful. Detroit, Cleveland, Buffalo, Rochester, NE states, other U.S. areas open. Box 7-150.

WELDING ENGINEER: B.S. in metallurgical, electrical or mechanical engineering, with experience in welding controls, power supplies and the metallurgical analysis of welds may make you qualified to hold the position of resistance welding engineer in one of Upstate New York's finest research and development laboratories. Write to: R. J. Sullivan, Electronics Park, General Electric Co., Syracuse, N.Y.

METAL SALES AND MARKETING OPPORTUNITY: Major importer with exclusive representation prime Western European companies seeks young man with basic knowledge metals for sales and marketing position. U.S. citizen with some knowledge French preferred. Experience foreign trade desirable. Best company benefits. Good salary. Reply in confidence to Box 7-150.

Midwest

METALLURGIST: Up to 15 years experience, for research and development position in the new central research laboratory of a nationally prominent automotive and truck parts manufacturer. Good theoretical background required in approaching a wide range of problems leading to new process and product developments. Excellent opportunity for advancement throughout the company. Please send resume. Salary open. Location: Detroit suburb. Box 7-25.

RESEARCH METALLURGISTS: For research programs related to welding techniques on refractory metals and super-alloys; high strength-high temperature alloys for missile and space applications; physical metallurgical studies on nickel, cobalt, titanium-base alloys; and recrystallization, diffusion, X-ray diffraction studies on refractory metals. Send resume to: R. J. Theibert, Employment Mgr., Tapco, Div. Thompson Ramo Wooldridge, 23500 Euclid Ave., Cleveland 17, Ohio.

ASSISTANT PROFESSORSHIP: Permanent academic position in metallurgical engineering, large university, teaching advanced undergraduate, graduate courses and research. Prefer relatively young Ph.D. with interest in thermodynamics and physical metallurgy. Some industrial experience desirable but not required. Salary dependent upon qualifications. Box 7-30.

MANUFACTURERS REPRESENTATIVE: National industrial furnace service company desires representatives in Ohio, Pennsylvania, Kentucky, Missouri and Iowa. Exclusive territories, high commissions, repeat orders, variety of products. Send details, present lines, background and area now covering to: Services Unlimited Inc., 2767 S. 71st St., Milwaukee 19, Wis.

South

METALLURGIST: Major aluminum producer desires metallurgist for control and project work. Must be capable of planning and estimating cost of projects as well as carrying out through final reports with minimum of supervision. Permanent position with liberal benefits. Submit resume with salary requirements to Box 7-35.

DEVELOPMENTAL AND RESEARCH PROJECTS: Immediate opening for man with B.S. in metallurgy or metallurgical engineering; 1 or 2 years experience or recent graduate. Work will be on both developmental and research-type projects. Experience with cobalt-base alloys and hard facing materials and techniques desirable. Write to: W. F. Cannon, Personnel Manager, Reed Roller Bit Co., P. O. Box 2119, Houston 1, Tex.

West

TEACHING: New, growing metallurgical engineering program. Position calls for inter-

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est in junior and senior level courses and laboratory development work. Industrial experience desirable but not essential. B.S. or M.S. in metallurgy necessary. Climate, working conditions and living conditions ideal. Write: R. C. Wiley, Welding and Metallurgical Engineering Dept., California State Polytechnic College, San Luis Obispo, Calif.

PHYSICAL METALLURGIST: For research and development in aluminum alloys and primary metal processing, with good education and background in basic principles and theory and wanting to apply research to solution of industrial problems, preferably with advanced degree in physical metallurgy. Write to: M. C. Fetzer, Dept. of Metallurgical Research, Kaiser Aluminum and Chemical Corp., Spokane 69, Wash.

Canada

QUEEN'S UNIVERSITY: Opening for extractive metallurgist, Sept. 1, 1961. Duties mostly research and graduate student supervision, with some teaching. Preference for Ph.D. in metallurgy or related field interested in application of physical chemistry or of chemical engineering concepts to metal extraction and refining. Rank and salary depend on qualifications. Apply to: F. A. Hames, Chairman, Metallurgical Engineering Dept., Queen's Univ., Kingston, Ont., Canada.

POSITIONS WANTED

METALLURGICAL ENGINEER: B.S. degree, age 33. Experienced in research and development of ferrous and nonferrous metals for use in missile and high performance aircraft application. Thorough knowledge of glass-to-metal sealing methods for semiconductor packaging. Married, family. Desires responsible position with challenging problems in Dallas, Tex., area. Box 7-40.

METALLURGICAL ENGINEER: B.S. degree, completed course work for M.S. in metallurgical engineering, age 25. Three years experience in nuclear metallurgy, including alloy development. Desires responsible position in development or production metallurgy, midwest. Box 7-50.

METALLURGICAL ENGINEER: Ph.D. in metallurgical engineering. Three years experience in evaluating ceramic nuclear fuel materials and studying fundamental mechanisms of liquid-metal mass transfer. Two years teaching metallurgy courses. Publications. Desires technical/administrative position. Resume on request. Box 7-55.

METALLURGIST: B.S. degree in metallurgical engineering. M.S. degree, with eight years diversified experience in metallurgical research. Specialties include high-temperature alloys, vacuum and arc melting, powder metallurgy, investment casting, high-temperature brazing and protective coatings. Present compensation $10,000 per year. Desires position in applied research and development. Box 7-60.

RESEARCH METALLURGIST: B.S. in metallurgical engineering, age 42, married, 3 children with 15 years experience in aluminum-base alloys, free machining and high-strength alloy development, investigation of aluminum powder alloys and aluminum pipers, magnesium-base alloys for forgings and elevated temperature use, process variables to improve magnesium-base alloy. Two years metallurgy of uranium and uranium-base alloy, two years study of oxidation of copper alloys. Publications and patent. Available immediately. Prefers West, but will relocate. Box 7-65.

METALLURGICAL ENGINEER: 1953 graduate. Diversified background in production and research with specialized knowledge of welding, including inspection. Desires position with medium-size progressive company as chief metallurgist or welding engineer, or position leading thereto. Willing to assume responsibility and get the job done. Minimum salary, $12,000. Box 7-70.

METALLURGICAL ENGINEER: M.S. degree, desires position with responsibility and opportunity. Twenty years diversified experience including supervisory positions in research, production and material development. Box 7-75.

DEVELOPMENT MANAGER: B.S. and M.S. degrees in metallurgical engineering. Business administration courses. Refractory materials-powdered metal products. Excellent background in materials, research and development, product and process development and developmental sales in the exotics and unusual powder products. Seeking administrative position in research and development, sales or product development. Box 7-80.

CHIEF METALLURGIST: Metallurgical engineer, graduate studies in industrial management, 18 years diversified experience in foundry, wire mill, rolling, forging, heat treating, research and development in nuclear field. Presently chief metallurgist in fabricating operation; desires management position in larger organization. Eastern U.S. preferred. Box 7-85.

TESTING LABORATORY SUPERVISOR: A.B. degree in chemistry-mathematics, age 33, married. Ten years experience in laboratory testing of copper alloys in a plant producing mill products, including over nine years in supervisory capacities. Experience includes both analytical and physical testing. Minimum salary $8000. Will consider related technical or administrative positions. Box 7-90.

METALLURGIST: M.S., B.S. degrees, age 34, married, 3 children. Five years in heat treatment of all types of steels, toolsteels and carbides including laboratory supervision, failure analysis, furnace atmosphere and heat treatment specifications. Three years in research and development including plasma sprayed coatings for aerospace vehicle components and stainless steel corrosion problems. Box 7-95.

SPONGE IRON MELTER, METALLURGICAL ENGINEER: Degree, with ten years operating experience melting sponge iron in all sizes of electric arc furnaces up to 80 tons. Also experience in the production of all classes of electric furnace steels. Resume on request. Box 7-100.

WELDING ENGINEER: Education in metallurgy, electronics and technical writing. Twenty years experience in all welding processses, including electron beam. Material experience includes aluminum and magnesium alloys, stainless steels, special steels, cobalt and nickel-base alloys, refractory materials and beryllium. Past ten years in research and development work as senior engineer. Box 7-105.

METALLURGIST: B.S. degree, successful record in handling of metallurgical processing of steel, corrosion control and inspection problems for highly regarded companies.

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the 3 minute glass

The fictional post-mark shown to the right becomes factual about the first of July when your ASM headquarters opens the doors of its own post office. Thus it will be that mail from ASM going out all over the world will bear the imprint "Metals Park, Ohio," and likewise the Society's mailing address becomes quite simply "American Society for Metals, Metals Park, Ohio".

Ever since it moved to its new headquarters building in late August 1959, ASM has had a mailing address with the unlikely name of "Novelty, Ohio". It appears that Novelty is a post office rather than a place. That portion of the rolling Geauga County countryside in which ASM is located is Russell Township, but step over the property line to the east and you find yourself in Newbury Township. Nowhere, though, will you find Novelty Township.

There are those who thought that the Novelty post office came after the fact of ASM and its geodesic dome with its "novel" appearance. But the post office of Novelty existed long before ASM moved to the country, and we suspect that it derived its name from the existence of a novelty store which undoubtedly was in itself a trade center for this immediate area.

Capricious inspiration for a post office name, such as Novelty, is not without precedent. Marion's father came from Pennsylvania Dutch country where the name of the quiet town originally was Uniontown. Eventually it was realized that there was a much larger Uniontown elsewhere in Pennsylvania and that this duplication would have to be eliminated. On the theory that the smaller Uniontown was "a good place to sleep", its post office name was changed to Pillow, a name which it bears to this day.

When Metals Park was under construction, a frequently asked question was "Aren't you concerned about being in a remote location?" One lighthearted answer was that it was true that Metals Park would be 23 miles further away from the Golden Gate (San Francisco) Chapter than when the national offices were located directly in Cleveland, but then it would be 23 miles nearer the New York Chapter. Which statement, of course, makes the rather important point that the individual services provided to members by ASM are carried on largely by benefit of the postal systems of the United States, Canada and nearly 50 other countries.

As a matter of fact, the "remoteness" of Metals Park has apparently added materially to its attraction to visitors. When the national offices of ASM were located on Euclid Ave. in Cleveland in the Norton mansion (now torn down) from 1940 to 1959, visitors rarely exceeded a couple of dozen a week. Since Metals Park was opened less than two years ago, visitors have well exceeded the 50,000 mark, and from all over the world.

Visitors to Metals Park who were not previously aware of metallurgy and metals engineering as an important ingredient of America's progress leave Metals Park with a new understanding. Too, they become aware of your Society and its continuing contribution to such progress.

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Managing Director

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METALLURGICAL ENGINEER: M.S., B.S. degrees, age 27, married. Five years experience in research and development includes extrusion, rolling, rotary piercing, drawing, heat treatment, powder compaction and high energy rate forming (Dynapak) of reactor and associated materials. Well known in field. Responsible for important government owned patents, reports, etc. Seeks position where ability is recognized and utilized. N.Y., Conn., N.J. area preferred. Q-cleared. Box 7-115.

GROUP LEADER: Ten successful years in metallurgical nuclear development at large AEC production installations. M.S. degrees in metallurgy and industrial management. Desires more administrative line responsibility. Color and black and white metallographic and mechanical test experience. Laboratory supervision applicable to any metallurgical research activity or industry. Resume on request. Box 7-120.

METALLURGICAL ENGINEER: M.S. degree, age 37, family. Eleven years experience in basic and applied research in physical and mechanical metallurgy. Extensive experience in high-strength steels including material selection, quality control and alloy development. Also broad background in X-ray diffraction, phase diagrams and crystal imperfections. Publications and program planning. Location, West Coast. Box 7-125.

SENIOR WELDING ENGINEER: Twelve years experience in heavy structural and alloy fabrication, seeking similar position or that of materials engineer in charge of welding development. Prefers San Francisco Bay area of Pacific Northwest. Thinks creatively in development of cost-cutting production techniques. Understands business management techniques. Age 44. Box 7-130.

X-RAY DIFFRACTION METALLURGIST: In charge of X-ray diffraction in large metallurgy department. Experience in X-ray fluorescence, electron microscopy, failure analysis. Recent graduate courses in physics, advanced X-ray diffraction. B.S. degree in metallurgy, graduate work under fellowship. Published articles on aluminum metallurgy. Box 7-135.

COST REDUCTION SPECIALIST: Graduate metallurgical engineer, age 39, family. Creative talent in the application of materials and processes. Excellent troubleshooter concerning failure, shop, forging, foundry and general metallurgical problems. Experienced in administrative, supervisory, quality control and material evaluation work. Desires challenging job where training and experience can be used to the utmost in lowering production and material costs. Box 7-140.

METALLURGICAL ENGINEER: M.S. degree, with excellent practical knowledge of high-temperature alloys, steels and nonferrous metals, acquired in over nine years of diversified experience in alloy development and materials application. Desires responsible position with challenging problems and opportunities for advancement. Age 38. Box 7-145.

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Graduate metallurgist, experienced with bronze and stainless steel foundry operations, problem solving, metallography, quality control, casting techniques, to administer product development with some customer contact. Company in Chicago area.

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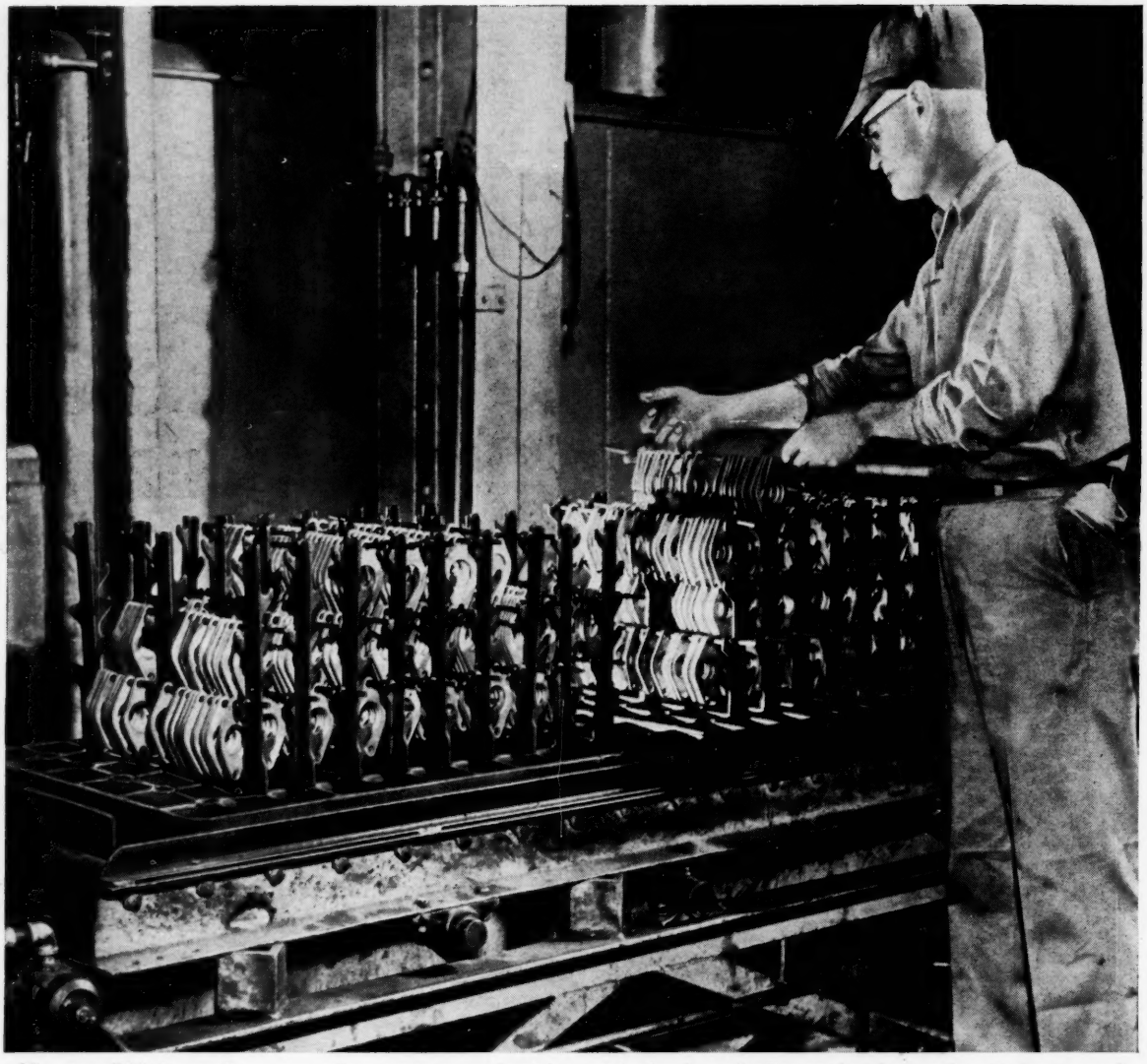

These cast HT alloy work trays carry farm tractor parts through endothermic, ammonia and carburizing atmospheres. Conveyor mechanism has a loading section that can be raised or lowered pneumatically, simplifying handling problem.

Cast high-nickel alloys...for outstanding performance in heat treating service

Work trays . . . loading fixtures . . . furnace parts . . . cast of Type HT* high-nickel alloy withstand 1650°F carbonitriding atmospheres.

Made at a well-known automotive plant, these farm tractor parts are destined for mass heat treating in a single, gas-fired carbonitriding furnace. Temperatures often go as high as 1550° to 1650°F, with cycles varying from 1½ to 5 hours.

To withstand these severe operating conditions, work trays and loading fixtures such as basket carriers, roller rails, rollers, are made of cast Type HT high-nickel alloy. So are other vital furnace parts—rail supports, roller rail spreaders, chain guides and fans.

With its excellent high-temperature strength — its casting ease and economy — Type HT high-nickel alloy is ideal for such heat treating fixtures. This austenitic alloy resists carburization—withstands thermal shock in reducing, oxidizing and nitriding atmospheres.

Type HT alloy is just one of a family of austenitic casting alloys whose high nickel content—*over 35%*—puts them in a class by themselves for heat treating service. Each has outstanding resistance to sustained high temperatures, thermal fatigue and most furnace atmospheres.

To help you select the best possible alloy, we offer the comprehensive booklet, "Heat Resistant Castings, Corrosion Resistant Castings... Their Engineering Properties and Applications." You'll find it useful when considering such design factors as sizes, shapes, atmospheres, load or cycling requirements. It's yours for the asking. *A.C.I. designation

THE INTERNATIONAL NICKEL COMPANY, INC.
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